



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Development And Optimization of Nano Structured Lipid Carriers NLCS Loaded with Febuxostat Using Box-Behnken Design for The Effective Management of Gout

Ashish Mishra*, Shikha Sharma

Department of Pharmaceutical Sciences, Lords University, Alwar, Rajasthan.

ARTICLE INFO

Published: 18 Nov 2025

Keywords:

Gout, NLC, Febuxostat, Bioavailability, Box-Behnken design, optimization

DOI:

10.5281/zenodo.17643073

ABSTRACT

Gout is a chronic inflammatory disorder characterized by deposition of monosodium urate crystals in the joints, leading to recurrent pain and inflammation. The present study aimed to develop and optimize nanostructured lipid carriers (NLCs) containing Febuxostat for enhanced solubility and bioavailability in the effective management of gout. A three-factor, three-level Box–Behnken design was employed to evaluate the effect of solid-to-liquid lipid ratio (X_1), stirring speed (X_2), and emulsifier concentration (X_3) on entrapment efficiency (Y_1), drug flux (Y_2), and percentage yield (Y_3). The optimized formulation containing Compritol 888 ATO and Capryol 90 (82.8:17.2 ratio), with 2.5 % Tween 80 and stirring speed of 2500 rpm, exhibited high entrapment efficiency (72.98 %), flux ($136.19 \mu\text{g cm}^{-2} \text{h}^{-1}$), and yield (92.89 %). The NLCs showed an average particle size of 344 nm, PDI of 0.309, and zeta potential of -22.67 mV , indicating good stability. The developed system demonstrated sustained in vitro release, confirming its potential as an effective delivery platform for Febuxostat in gout management.


INTRODUCTION

Gout is a chronic metabolic disorder characterized by the deposition of monosodium urate crystals in joints and surrounding tissues, resulting from persistent hyperuricemia [1]. The condition is associated with episodes of intense pain, inflammation, and swelling that significantly

affect the quality of life. Febuxostat, a xanthine oxidase inhibitor, has shown superior efficacy in lowering serum uric acid levels compared to allopurinol [2-4]. However, its therapeutic potential is limited by poor aqueous solubility, variable bioavailability, and extensive first-pass metabolism, which collectively restrict its clinical performance. To overcome these biopharmaceutical challenges, lipid-based

*Corresponding Author: Ashish Mishra

Address: Department of Pharmaceutical Sciences, Lords University, Alwar, Rajasthan.

Email : Asm_mishra@yahoo.co.in

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



nanocarrier systems have emerged as an effective strategy for improving the solubility and absorption of poorly water-soluble drugs [5-6]. Among them, **Nanostructured Lipid Carriers (NLCs)** represent a promising second-generation lipid nanoparticle system composed of a blend of solid and liquid lipids stabilized by surfactants [7]. This hybrid structure provides greater drug-loading capacity, controlled release behavior, and enhanced physical stability compared to solid lipid nanoparticles (SLNs) [8-9]. By tailoring lipid composition and surfactant concentration, NLCs can improve oral delivery and prolong the systemic circulation of lipophilic drugs like Febuxostat. Design of Experiments (DoE)-based statistical optimization, particularly the **Box- Behnken design**, offers a systematic and efficient approach to identify the critical formulation and process variables influencing NLC characteristics [10-11]. Through this model, interactions between variables can be assessed while minimizing experimental runs, leading to optimized formulations with desirable particle size, entrapment efficiency, and drug release profile [12]. The present study focuses on the **development and optimization of Febuxostat-loaded NLCs** using the Box- Behnken design approach to enhance its solubility, bioavailability, and therapeutic efficacy in the management of gout. The optimized nanocarrier system aims to provide sustained drug release, improved pharmacokinetic behavior, and reduced dosing frequency, ultimately contributing to better patient compliance and therapeutic outcomes.

MATERIALS & METHODS

All ingredients used were of analytical grade. Febuxostat was procured from Yuventis Pharmaceuticals Baddi, HP, India. All solvents were purchased from Qaulikems. Compritol 888 ATO and Capryol 90 were obtained from

Gattefosse India. Tween 80 and Poloxamer 188 were purchased from Sigma-Aldrich (Mumbai, India).

Development of NLCs

Box- Behnken Design

To study the effect of three independent variable X₁ (Solid lipid to liquid lipid ratio), X₂ Stirring speed (rpm), X₃ Emulsifier concentration (% v/v) on the following dependent responses Y₁: Entrapment Efficiency (% w/w), Y₂: Drug Flux ($\mu\text{g}/\text{cm}^2/\text{h}$), Y₃: Percentage Yield (% w/w), Each factors were assessed at 03 different levels (-1, 0, +1). A total of 17 experimental runs were generated, including 12 factorial points and 5 center points to evaluate experimental error and model adequacy

Statistical Analysis

The design was executed using Design-Expert software (Version 9.0.3.1, Stat-Ease Inc., Minneapolis, MN, USA)

Preparation of NLCs

Preparation of Lipid phase: weigh and melt the solid lipid compritol and mix with liquid lipid capryol 90 at above the 5-10 degree above the melting point of the solid lipid. Dissolve the drug Febuxostat in the melted liquid. Preparation of Aqueous phase was done by a hot aqueous phase solution of surfactant tween 80/ poloxamer 188 at the same temperature as the lipid phase. and add necessary co surfactant. Emulsification was done under high speed magnetic stirrer add aqueous phase to lipid melt dropwise to form O/W emulsion. Use high shear homogenizer for 5-10 mins pulse mode to form nanoEmulsion. Solidification by cooling was done by submerging the Nanoemulsion into cold water/ice container for



2 hours to induce solidification of liquid globules as NLCs [13-15].

Table 1: Independent Variables and their Levels in BBD

Formulation Variables	Low (-1)	Medium (0)	High (+1)
-----------------------	----------	------------	-----------

X1: Solid lipid to Liquid lipid ratio	75:25	80:20	85:15
X2: Stirring Speed (rpm)	1500	2000	2500
X3: Emulsifier Concentration (% v/v)	1.5	2.0	2.5

Table 2: Experimental Runs for Box-Behnken Design

Batch No.	X1: Lipid Ratio	X2: Stirring Speed (rpm)	X3: Emulsifier Conc. (% v/v)
B1	-1	-1	0
B2	1	-1	0
B3	-1	1	0
B4	1	1	0
B5	-1	0	-1
B6	1	0	-1
B7	-1	0	1
B8	1	0	1
B9	0	-1	-1
B10	0	1	-1
B11	0	-1	1
B12	0	1	1
B13	0	0	0
B14	0	0	0
B15	0	0	0
B16	0	0	0
B17	0	0	0

Determination of % EE Y₁

To determine the entrapment efficiency, an accurately weighed quantity (50 mg) of the NLC formulation was dispersed in phosphate buffer (pH 6.8) and subjected to extraction for 24 hours. After equilibration, the dispersion was centrifuged at 3500 rpm for 10 minutes, and the supernatant was collected. The concentration of free (unentrapped) Febuxostat was quantified using a UV-Visible spectrophotometer at λ 315 nm.

The percent entrapment efficiency was calculated using the following equation:

$$\text{Entrapment Efficiency (\%)} = \frac{\{\text{Total Drug}\} - \{\text{Unentrapped Drug}\}}{\{\text{Total Drug}\}} \times 100$$

All measurements were conducted in triplicate to ensure reproducibility.

Determination of Drug Flux (Y₂)

In vitro permeation studies were carried out using a Franz diffusion cell, where a pre-treated dialysis membrane (MWCO 12,000–14,000 Da) was mounted between the donor and receptor compartments. The effective surface area of the membrane was 2.54 cm², and the receptor compartment contained 20 mL of phosphate buffer (pH 6.8) maintained at 37 ± 0.5°C under constant

stirring at 200 rpm. Febuxostat-loaded NLCs were applied to the donor compartment, and aliquots (0.5 mL) were withdrawn at predetermined intervals up to 24 hours. Each sample was replaced with fresh buffer. The amount of drug permeated was measured spectrophotometrically, and the flux (J) was calculated from the slope of the linear portion of the cumulative drug release vs. time plot, using

$$J = \frac{Q}{A \times t} \quad \text{or} \quad Q = J \times A \times t$$

Where:

J = Flux ($\mu\text{g}/\text{cm}^2/\text{h}$)
 Q = Amount of drug permeated (μg)
 A = Surface area of membrane (cm^2)
 t = Time (h)

Determination of Percentage Yield (Y_3)

The percentage process yield was calculated by accurately weighing the total dried NLCs obtained after lyophilization or vacuum drying. The formula used was:

$$\{\text{Process Yield (\%)}\} = \frac{\{\text{Weight of Dried NLCs}\}}{\{\text{Total Weight of Lipids + Drug}\}} \times 100$$

This parameter is crucial for evaluating the efficiency of the production process and minimizing formulation losses.

Optimization of formulation

In-vitro release studies

Percentage *in vitro* drug release of the prepared NLC's was determined using dialysis sac method. NLC equivalent to 5mg of Febuxostat were enclosed into the sac tied from both end with a thread. The sac was attached with the shaft of USP type II apparatus and ensured that it remain submerged in 200 ml of phosphate buffer pH 7.4.

The temperature was maintained at 37 C and rpm was set at 50. At regular time interval 5 ml sample was removed and analysed spectrophotometrically at 317 nm [16].

High Resolution Transmission Electron Microscope

Transmission electron microscopy (TEM) images were captured utilizing a JEM 2100 PLUS JEOL device. The preparation of samples involved the dropping of 10 μl of NLCs onto a copper grid containing 10 % phosphotungstic acid [17]. The determination of size distribution was accomplished through the utilization of software to analyze a comprehensive HRTEM image.

Determination of Particle Size and Polydispersity Index

The particle size and polydispersity index (PDI) of optimized batch of FEN-NLC was measured by dynamic light scattering (DLS) at 25°C using a computerized system (Beckman zeta sizer Delsa Nano C, Switzerland, ver. 3.73/2.30). The PDI was determined to find the size distribution of the prepared NLCs. The measurement was taken at 25° C using disposable sizing cuvette at count rate of 165.6 kcps. Dispersant used was double distilled water having refractive index and viscosity of 1.330 and 0.8800 cP, respectively. The measurement was taken in triplicate (n = 3) after diluting the sample (500 \times) in dispersant.

Zeta Potential (ζ) Analysis

The optimized batch of FEB-NLC was characterized by zeta potential (ζ) analysis using Beckman Zeta sizer, at 25°C. The measurement was taken using clear disposable zeta cell at count rate of 29.3 kcps. Dispersant used was double distilled water. Measurement was

carried out after dilution of sample with dispersant to reach a suitable concentration.

RESULT AND DISCUSSION

Statistical assessment of % EE (Y1)

The quadratic model was found to be statistically significant for %EE based on the fit summary results. The adjusted R^2 (0.9907) and predicted R^2 (0.9532) values differed by less than 0.2 (Table A), suggesting a good correlation between predicted and actual data. The lack of fit p-value (0.0874) was greater than 0.05 (Table B), indicating the model fits the data well and is not significantly flawed. The quadratic model was therefore selected as the best-fit model to interpret the response variable Y1 (%EE). X_1 (Solid:Liquid lipid ratio) and X_2 (Stirring speed) had antagonistic effects (negative coefficients), decreasing %EE. X_3 (Emulsifier concentration) had a synergistic effect (positive coefficient), increasing %EE. The curvature effects (X_1^2 , X_2^2 , X_3^2) indicate significant quadratic relationships, especially for X_1^2 ($p < 0.01$).

Statistical Assessment of Flux (Y2)

The statistical assessment of the flux (Y2) of Febuxostat-loaded NLCs was performed using Design-Expert® software based on a Box–Behnken design. The quadratic model was found to be most suitable, as evidenced by a minimal difference between adjusted R^2 (0.9846) and predicted R^2 (0.9271), both values being within the acceptable threshold difference of < 0.2 . The model p-value was observed to be 0.0123 ($p < 0.05$), confirming that the selected model was statistically significant. The lack of fit p-value was 0.0652 ($p > 0.05$), indicating that the lack of fit was insignificant and the model adequately described the experimental data.

All three independent variables—solid lipid: liquid lipid ratio (X_1), stirring speed (X_2), and emulsifier concentration (X_3)—exhibited significant influence on the flux of Febuxostat ($p < 0.05$). Additionally, the quadratic effects of X_1^2 and X_3^2 were also found to be significant ($p < 0.05$). From the regression analysis, the following polynomial equation was obtained for predicting flux (Y2).

Statistical Assessment of % Yield (Y3)

The difference between adjusted R^2 (0.9960) and predicted R^2 (0.9903), as observed from the fit summary statistics, was less than 0.2. The model p-value for Y3 was reported as < 0.0001 , indicating a statistically significant model ($p < 0.05$). The lack of fit p-value for Y3 was 0.6928 ($p > 0.05$), implying the model fit was appropriate with no significant deviation. Hence, a quadratic model was confirmed as the best fit for predicting % yield.

Among the independent variables, solid lipid: liquid lipid ratio (X_1), stirring speed (X_2), and emulsifier concentration (X_3) had statistically significant effects on Y3 ($p < 0.05$). The quadratic terms of X_1^2 , X_2^2 , and X_3^2 were also significant, indicating curvature effects. The interaction terms X_1X_2 and X_2X_3 were not statistically significant ($p > 0.05$).

The polynomial equation derived for Y3 is:

$$Y_3 = 73.53 + 16.55X_1 - 1.95X_2 - 1.23X_3 - 0.8925X_1X_2 - 3.62X_1^2 + 3.48X_2^2 + 3.96X_3^2$$

This equation suggests:

X1 (solid:liquid lipid) had a synergistic effect on yield (positive coefficient), X2 (stirring speed) and X3 (emulsifier concentration) had antagonistic effects (negative coefficients). Higher solid lipid content likely promoted particle solidification, increasing yield. However, excessive stirring or surfactant could have led to material loss or unstable emulsification, lowering the yield.

$$Y_2 = 104.15 + 5.37X_1 + 14.92X_2 + 12.05X_3 - 1.43X_1X_2 + 0.695X_1X_3 + 5.11X_2X_3 - 2.75X_1^2 - 0.7835X_2^2 - 2.73X_3^2$$

This equation suggests a synergistic effect of all three factors on flux, with the stirring speed (X2) showing the strongest contribution ($b_2 = +14.92$), followed by emulsifier concentration (X3) and solid lipid: liquid lipid ratio (X1). These positive coefficients imply that increasing any of the three variables enhances the flux of Febuxostat.

The synergistic effect of increased stirring speed may be attributed to the formation of smaller NLC particles, which enhance permeation by increasing

surface area. Similarly, higher emulsifier concentration likely improved wettability and solubilization of Febuxostat in the lipid matrix, facilitating its diffusion across the membrane. On the other hand, curvature effects ($X1^2$ and $X3^2$) suggest that excessively high lipid ratio or emulsifier concentration may negatively impact flux beyond optimal levels due to possible aggregation or increased viscosity.

Optimization

The optimal values of formulation composition and process variables for optimized FEB-NLCs was found 82.8:17.2 of solid lipid: liquid lipid (X1), 2500 rpm of stirring speed (X2) and 2.5 % of emulsifier concentration (X3) having desirability function of 0.874 as analyzed by Design Expert Software. In addition to this, it gives theoretical/predicted values of EE (%) (Y1), Flux (Y2) and Yield % (Y3) corresponding to 72.98%, 136.19 $\mu\text{g}/\text{cm}^2/\text{h}$ and 92.89%, respectively (Fig.1 a & b).

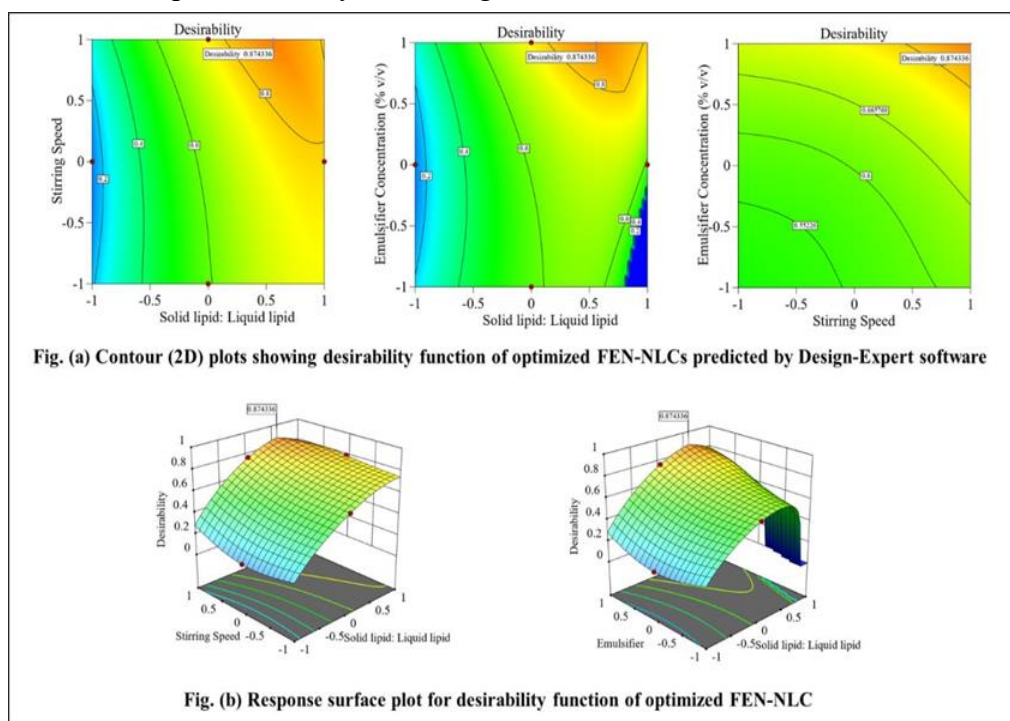


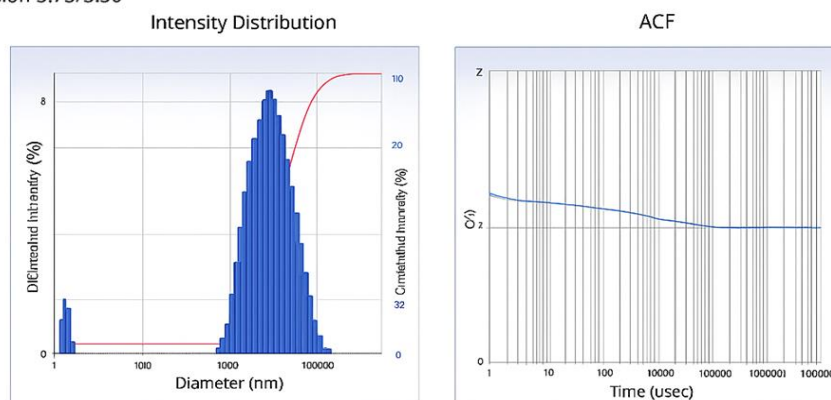
Figure 1(a): Contour plots and Figure 1(b): 3D surface response showing desirability function of optimized FEB-NLCs.

Particle size and zeta potential

The developed FEB-NLCs showed an average particle size of 344 nm and PDI of 0.309 as depicted in Fig.2. Usually a zeta potential of $\geq \pm 25$ mV is recommended for achieving stable dispersions. The zeta potential was found to be -22.67 mV as shown in Fig. 3. Lower PDI and high negative value of zeta potential suggested

homogenous distribution of NLCs and physically stable system without aggregates. This may be achieved due to tween 80 attributed stabilized nanoparticles and negative charge distribution over the surface responsible for repulsion among them. Small size offers a greater surface area for association and permeation through the skin to the deeper layers of tissues.

ersion 3.73/3.30



Distribution Results (Contin)

Peak	Diameter (nm)	Std. Dev.
1	18	0.5
2	400.9	290.2
3	0.0	0.0
4	0.0	0.0
5	0.0	0.3
Average	382.4	293.3
Residual :	5.138e-004	(O.K.)

Cumulants Results

Diameter (C)	348.2	(nm)
PolydispersityIndex (P.I)	0.284	
Diffusion Const. (D)	1.427e008	(cm ² /sec)

Measurement Condition

Temperature	25.1	(°C)
Diluent Name	WATER	
Refractive Index	1.3325	(cP)
Viscosity	0.8871	(cps)
Scattering Intensity	320157	(cps)

Fig. 2. Particle size of NLCs of Febuxostat

Version 3.73 / 2.30

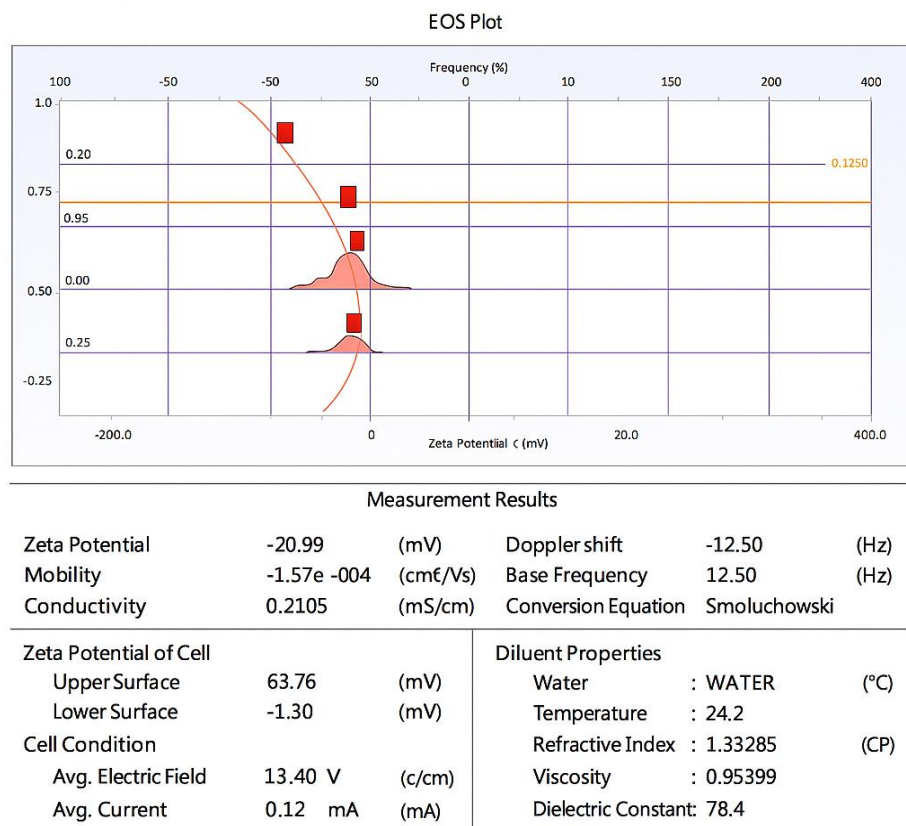


Fig. 3 Zeta potential of NLCs of Febuxostat

High Resolution Transmission Electron Microscope (HRTEM) of the FEB- NLCs

The high magnification power of the transmission electron microscope made possible a visual inspection of the spherical nanostructures present in the formulation sample. Fig. 4 depicts NLCs exhibiting a characteristic spherical morphology, with a particle size of 200 nm.

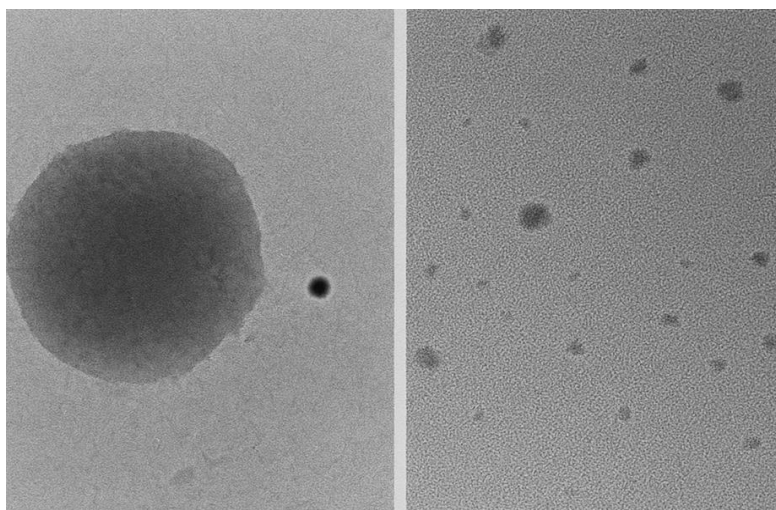


Fig. 4. HRTEM of NLCs of Febuxostat

***In-vitro* release**

The cumulative drug release profile of the prepared formulations was evaluated over a period of 12 hours, as depicted in Fig. 5. During the initial phase (first two hours), the nanostructured lipid carrier (NLC) system exhibited a distinct burst release pattern. This rapid release may be attributed to the diffusion of Febuxostat located near or on the surface of the nanoparticles. The optimized batch demonstrated a markedly higher percentage of drug release compared to the plain drug suspension, which can be ascribed to the increased proportion of liquid lipid in the formulation. The liquid lipid component, predominantly situated in the outer regions of the NLC matrix, enhances the solubilization of

hydrophobic drugs and facilitates an initial rapid release phase.

Subsequently, a sustained release pattern was observed, indicating gradual diffusion of the entrapped drug from the solid–lipid matrix into the surrounding medium. The release data were analyzed using various kinetic models—zero-order, first-order, and Higuchi models—to elucidate the mechanism of drug release, as illustrated in Figure 6. Among these, the Higuchi model provided the best fit, as reflected by the highest correlation coefficient (R^2) values summarized in Table 4. This suggests that the release of Febuxostat from the NLC formulation primarily follows a diffusion-controlled mechanism governed by the drug's movement through the lipid matrix.

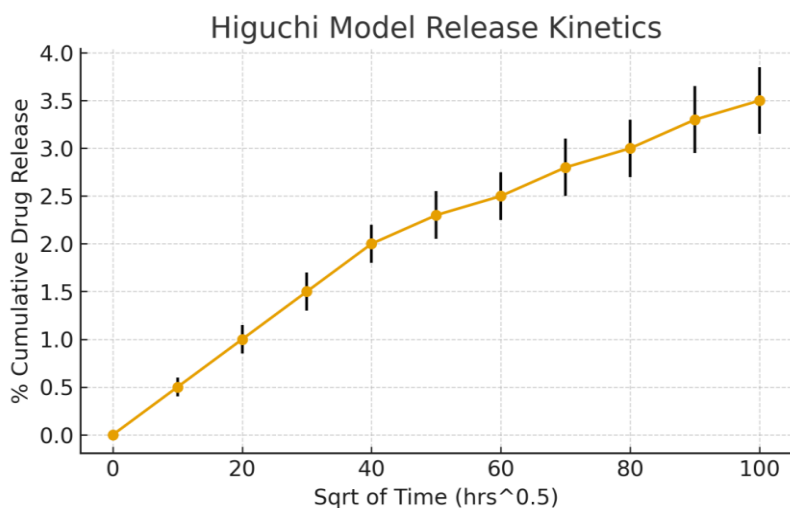


Fig: 5 Higuchi model for obtained drug release

Table 4: R square value and slope of drug release kinetics by different models.

Sr No	Model	R ²	Slope
1	Zero Order	0.965	6.381
2	First Order	0.953	-0.054
3	Higuchi equation	0.981	0.039
4	Korsenmeyer Peppas	0.648	1.075

CONCLUSION

The study successfully developed and optimized Febuxostat-loaded nanostructured lipid carriers using the Box–Behnken design. The optimized formulation demonstrated high entrapment efficiency, satisfactory yield, and enhanced drug flux. Characterization studies confirmed nanosized particles with uniform distribution and good stability. The NLC system exhibited sustained *in vitro* drug release, indicating its potential to may improve the oral bioavailability and therapeutic efficacy of Febuxostat in the management of gout. Further *in vivo* and pharmacokinetic evaluations are warranted to confirm its clinical applicability.

Conflict of Interest All authors of this research declare no conflict of interest.

REFERENCES

1. Perez-Ruiz, Fernando, Nicola Dalbeth, and Tomas Bardin. "A review of uric acid, crystal deposition disease, and gout." *Advances in therapy* 32, no. 1 (2015): 31-41.
2. Cicero, Arrigo FG, Federica Fogacci, Raffaele Ivan Cincione, Giuliano Tocci, and Claudio Borghi. "Clinical effects of xanthine oxidase inhibitors in hyperuricemic patients." *Medical principles and practice* 30, no. 2 (2021): 122-130.
3. Jordan, Andreas, and Ursula Gresser. "Side effects and interactions of the xanthine oxidase inhibitor febuxostat." *Pharmaceuticals* 11, no. 2 (2018): 51.
4. Lin, Zhijian, Jeetendra Kumar Gupta, Mohsin Maqbool, Krishan Kumar, Ayushi Sharma, and Nitin Wahi. "The therapeutic management of chemical and herbal medications on uric acid levels and gout: modern and traditional wisdom." *Pharmaceuticals* 17, no. 11 (2024): 1507.
5. Kesharwani, Roohi, Pankaj Jaiswal, Dilip Kumar Patel, and Pankaj Kumar Yadav.



- "Lipid-based drug delivery system (LBDDS): An emerging paradigm to enhance oral bioavailability of poorly soluble drugs." *Biomedical Materials & Devices* 1, no. 2 (2023): 648-663.
6. Teixeira, M. C., C. Carbone, and E. B. Souto. "Beyond liposomes: Recent advances on lipid based nanostructures for poorly soluble/poorly permeable drug delivery." *Progress in lipid research* 68 (2017): 1-11.
 7. Viegas, Cláudia, Ana B. Patrício, João M. Prata, Akhtar Nadhman, Pavan Kumar Chintamaneni, and Pedro Fonte. "Solid lipid nanoparticles vs. nanostructured lipid carriers: a comparative review." *Pharmaceutics* 15, no. 6 (2023): 1593.
 8. Sivadasan, Durgaramani, Muhammad Hadi Sultan, Osama Madkhali, Yosif Almoshari, and Neelaveni Thangavel. "Polymeric lipid hybrid nanoparticles (plns) as emerging drug delivery platform—A comprehensive review of their properties, preparation methods, and therapeutic applications." *Pharmaceutics* 13, no. 8 (2021): 1291.
 9. Anwer, Md Khalid, Essam A. Ali, Muzaffar Iqbal, Mohammed Muqtader Ahmed, Mohammed F. Aldawsari, Ahmed Al Saqr, Mohd Nazam Ansari, and M. Ali Aboudzadeh. "Development of sustained release baricitinib loaded lipid-polymer hybrid nanoparticles with improved oral bioavailability." *Molecules* 27, no. 1 (2021): 168.
 10. Rangaraj, Nagarjun, Saurabh Shah, Maruthi AJ, Sravanthi Reddy Pailla, Hanumanth Srikanth Cheruvu, and Sunitha Sampathi. "Quality by design approach for the development of self-emulsifying systems for oral delivery of febuxostat: pharmacokinetic and pharmacodynamic evaluation." *AAPS PharmSciTech* 20, no. 7 (2019): 267.
 11. Qazafi, Shehram, Danish Mazhar, Dur E. Nayab, Hussain Ali, Salman Khan, and Saeed Ahmad Khan. "Nanocarrier-Based Approach: Solid Lipid Nanoparticles for the Enhanced Bioavailability of Febuxostat." *BioNanoScience* 15, no. 2 (2025): 1-18.
 12. Alshahrani, Saad M., Hadil Faris Alotaibi, and Mohammed Alqarni. "Modeling and validation of drug release kinetics using hybrid method for prediction of drug efficiency and novel formulations." *Frontiers in Chemistry* 12 (2024): 1395359.
 13. Qazafi, Shehram, Danish Mazhar, Dur E. Nayab, Hussain Ali, Salman Khan, and Saeed Ahmad Khan. "Nanocarrier-Based Approach: Solid Lipid Nanoparticles for the Enhanced Bioavailability of Febuxostat." *BioNanoScience* 15, no. 2 (2025): 1-18.
 14. Maddukuri, Muralikrishna. "Formulation and Evaluation of Solid Lipid Microparticles of Clopidogrel." Master's thesis, Rajiv Gandhi University of Health Sciences (India), 2013.
 15. Ramadan, Alyaa Adel. "A study of some lipid-based drug delivery systems." PhD diss., Université d'Angers, 2010.
 16. Gurumukhi, Vishal C., Vivek P. Sonawane, Ganesh G. Tapadiya, Sanjaykumar B. Bari, Sanjay J. Surana, and Shailesh S. Chalikwar. "Quality-by-design based fabrication of febuxostat-loaded nanoemulsion: statistical optimization, characterizations, permeability, and bioavailability studies." *Heliyon* 9, no. 4 (2023).
 17. Radwan, Ibrahim Taha, Mohamed Z. Sayed-Ahmed, Nirvina AbdelRaouf Ghazawy, Saad S. Alqahtani, Sarfaraz Ahmad, Nawazish Alam, Abeer Mousa Alkhaibari, Md Sajid Ali, Abdelfattah Selim, and Eman Alaaeldin AbdelFattah. "Effect of nanostructure lipid carrier of methylene blue and monoterpenes as enzymes inhibitor for *Culex pipiens*." *Scientific Reports* 13, no. 1 (2023): 12522.



HOW TO CITE: Ashish Mishra*, Shikha Sharma, Development and Optimization of Nano Structured Lipid Carriers NLCS Loaded with Febuxostat Using Box-Behnken Design for The Effective Management of Gout, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 11, 2725-2736 <https://doi.org/10.5281/zenodo.17643073>

